MONA JIMINEZ: So it's December 4th, 2010, in Owego. Hank Rudolph, Mona Jimenez, Kathy High. Okay, great.

So Hank, I was hoping that we could cover a couple of things that have to do with the evolution of this center and sort of how the tools evolved, but also how artists are using the center, in your experience. But the first thing I thought we could start out with was really by understanding voltage control as a concept. And so I was hoping you could just explain that as sort of a concept that was used and is used in the center.

HANK RUDOLPH: Well, voltage control was borrowed from audio synthesis in[?] electronic music. And it was a concept— voltage control, as opposed to manual control. So instead of turning something with a knob or switch or whether it was a continuous parameter or on/off, you could do this with an electronic signal. And that electronic signal, for something that changes continuously, whether it's brightness or contrast of the signal or mixing between the two things, you— One source of voltage control is an oscillator, which is basically cyclical in nature. So it's going up and down and up and down. And you could have different oscillators that are not synchronized to one another, changing different parameters in and out of phase, to create a more complex rhythmic situation. And another source of voltage control is pre-existing audio. Like somebody has something on tape or a live microphone or something; that goes through a device called an envelope follower, and that basically translates changes in volume of the sound to changes in voltage. So as I speak louder or softer, it can change those parameters, like brightness and contrast or whatever, the same as, you know, as an oscillator can, but it's

RUDOLPH (Cont.): synched to the sound. But only with the parameter of volume; it doesn't change by tone, by the pitch. There is something called frequency voltage converters, but unless the sound is relatively simple, it gets confused pretty easily. So only certain— you know, certain sounds work better than others. Right? Ambient audio from the subway probably is not going to work as well as birds chirping or, you know, somebody drumming or somebody speaking in a very kind of staccato-type way.

JIMINEZ: So you make a corollary, as to like a high contrast sound?

RUDOLPH: Yeah, mm-hm.

JIMINEZ: So things that have a really wide range of volume?

RUDOLPH: Yeah, mm-hm.

KATHY HIGH: So similar to the picture brightness. You know, a greater brightness would be a higher voltage and less brightness, lower voltage. And then so higher volume or more amplitude is more voltage and less amplitude, less voltage.

RUDOLPH: Yeah.

JIMINEZ: So then how does that relate to the plus and minus— I don't know what you would call that. Is that a standard or a specification that— or the— You're using this plus and minus system—

RUDOLPH: Yeah, our system is referred to as the plus/minus five volt system, which is kind of a cryptic name, but it's kind of a generic term for this system that's not quite audio, it's not quite video, but it can be applied to all of those things. And there is where David would be more useful. But I think they came up with this voltage range because it was compatible with preexisting— with a lot of preexisting audio synthesis devices that were out at the time. Which ones, [laughs] I couldn't tell you, but I know other use zero to[?] five or things like that.

HIGH: And I think the Sandin[sp?] uses, what, plus/minus one volt?

RUDOLPH: Yeah. Or I think plus/minus a half a volt.

HIGH: A half a volt [inaudible].

RUDOLPH: So yeah, it's a tenth of that. That's closer to what video is, because video is around one volt when it's turned[?] [inaudible].

JIMINEZ: Peak to peak?

RUDOLPH: Yeah, yeah. And the Sandin really is a different kind of architecture, because unlike the Jones modules, all the video is happening through— Well, we use the Matrix switcher, but it's all regular video, two volts—you know, two volts un-terminated, one volt terminated—going through the video devices; and then all the control voltage inputs are mini-jacks on the front panels or somewhere near there, that take plus/minus five in[?]. So they're two completely different standards. And there are some cases where you can take a plus/minus five signal and attenuate it to two volts, so that it can go directly into the matrix as an image source; but for the most part, David's devices were designed to take the control voltages in through the mini-jack. And that's very different from the Sandin, where everything is in the same kind of plus/minus half a volt soup. And there might not even been specific things on there that say control voltage. If you want to pulse an image, you might take an oscillator and a video image and put them through a mixer. And then how much of one or the other is on there will determine how it pulses. So it's a little different that way.

JIMINEZ: So when did you come to the Center?

RUDOLPH: Well, by come to the Center— Let's see. I went to school here in the mid to late seventies, when the Center was in Binghamton. And at that time, it was just sort of at the end of when students could use the Center, before the New York State Council on the Arts said, "Well, this is double funding because one's arts related, one's education related." I still managed to volunteer to do stuff in exchange for using the equipment or something, but I think I was one of the last students. I think Neal Sussman[sp?] and Isaac

RUDOLPH (Cont.): Jackson[sp?] and I were, like among the last students to do that. And then the Center moved to Binghamton[?] in ’79, and then I was sort of around. Peer got a teaching job up in Buffalo in ’84. It was a one-year teaching job, and then he was on unemployment for six months, so I did it for a year and a half. And then when he came back, he did this job, I think for maybe another year and a— or I think another year, before he got a job a Alfred. And then I came back full-time in ’87. I don’t know if that works out. So I’ve been here continuously since ’87. But I’d been sort of around…

JIMINEZ: Right.

RUDOLPH: …before that, as a student, as just a volunteer, or just hanger on. [they laugh]

JIMINEZ: So you were introduced to voltage control as a student. That was always part of the— Was that part of the toolset or whatever of the Center?

RUDOLPH: Back— I remember when Rich Brewster was building yellow boxes—I was a student—and he was also building some video modules. So it wasn’t David’s designs, per se, but David, I don’t think was around at that point. Initially, I was just using these big— I mean, the Center had these big oscillators that— I think they were, like Army surplus oscillators. They were these giant silver things that put out square waves and stuff. And there was this modified Sony special effects generator—I think it was modified by David—so it had other features like keyers, and then there was a Jones

RUDOLPH (Cont.): keyer. So I just kind of came in, would put that together with some black and white cameras and just use it as such. I'm trying to remember, when I first came here, what had voltage control. Some devices, voltage control was an option, and then some devices don't do anything without voltage control. And the wobbulator is an example of a device that has to have voltage control. And I think when I came here, the wobbulator did have those big Army surplus oscillators plugged into it. So the first voltage control devices were the yellow boxes, that I can remember. And at the same time, when I was trying to understand it, there was a course offered in the music department at Binghamton, where they still had the Moog, the big Moog synthesizer. So I had taken that course and was learning voltage control there. And also there was this great essay in a book. I can't remember the name of the book, but Joel Chadabe wrote the essay in it. It was on voltage control synthesis. And I really understood from that, what voltage control did and how there're second levels of control voltages and things like that, and how to read a flow chart and, you know, all that good stuff. So then from there, I was able to apply it to ideas in video, once those modules were finished at the center.

JIMINEZ: It does seem like those ideas were floating around. I mean, you know, and a lot of people will tell stories. Like Bill Letcher[?] tells stories at parties, where they had oscillators into TVs or—

RUDOLPH: Mm-hm.

JIMINEZ: Or other people will talk about, Yeah, I was a teenager and I plugged in my— you know, tried to make my TV image be weird by applying some voltages to it or— Or you know, of course, Nam June, with the magnets and whatnot. So what was your perception or experience of that, of those ideas floating around?

RUDOLPH: Well, it definitely had its foundations in music, in audio, before. And I think there was an essay written by Peer's father about modularity in[?] voltage control in the early sixties, that was some pivotal essay about how to approach this. It's interesting that in both—you know, jumping ahead to Max/MSP and Jitter, and going back to voltage control—that in both cases, these started off as audio systems. You know, this very elaborate architecture was devised for working with audio, and that the video aspect was an afterthought. Or the visual aspect was an afterthought. So you know, the system was already in play, and then visuals, moving images, were kind of plugged into that concept. So let's see. In terms of— I mean, I had been very interested. I was very interested in the idea of connections between audio and video. And I remember at that point, there wasn't that much to read; there wasn't that much written information on audio synthesis, and there was *nothing* on video synthesis. And in fact, I was in Wisconsin in '73 and David Bordwell, a film theorist who taught there, told me about this guy Nam June Paik who was coming, and he uses a thing called video synthesizers. That was the first time I'd ever heard of it so— And then I saw him speak and I was just really fascinated by it. So that was one of the reasons I eventually wound up at school in Binghamton. Somebody else had told me— Isaac Jackson had told me about Binghamton and we both came up here together.

JIMINEZ: Was there a lot of interaction between the audio side and the video side then, in terms of the departments?

RUDOLPH: You mean at Binghamton?

JIMINEZ: Yeah.

RUDOLPH: No.

JIMINEZ: Or what had you heard?

RUDOLPH: I knew about the TV Center and I knew about the cinema department. And in fact, I didn't know that there was anything with audio, electronic music at the music department at all. In fact, it was pretty short-lived. I think it ended right after that and then the Moog sat in a room by itself for years and years. And Ralph kept saying, "What are you doing with it? What are you doing with it?" Eventually— [laughs] He eventually got it and it's in his house. But yeah. The music department— Binghamton's very unusual, in that media arts is the least conservative of the departments, of the fine arts departments. [laughs] Usually, you know, communications departments tend to me more conservative, and that wasn't the case at Binghamton. So the music department, the theater department were very conservative, so there was no— I don't think there was any interaction; it was just kind of a fluke that that course was offered [laughs] that semester, in electronic music, and I happened to get in.

JIMINEZ: Yeah, because we're close to Germansburg[?] or whatever.

RUDOLPH: Yeah. [they laugh] Right, exactly.

JIMINEZ: You know, you mentioned the Serge modules, and is that what the yellow boxes were built on? What were those serve modules? And you mentioned, in another discussion with you, the *Electronotes* newsletter.

RUDOLPH: *Electronotes* was this guy Bernie Hutchins, who I think was an engineer at— he was an engineering student at Cornell. I never met him, but he started— I think he stayed in that area and started publishing these newsletters that were— This was, like very, very DIY stuff. This was like, You can make your own oscillators and voltage control amplifiers and stuff like that. And he listed the parts and— And so yeah, that newsletter was circulating.

JIMINEZ: Was that when you were in school or [inaudible]?

RUDOLPH: It was during the seventies, yeah. And I don't know— I mean, of course, this was at the same time that Bob Moog was in Trumansburg, so I don't know if those two ever interacted at all or one inspired the other or anything like that, but they seemed to be happening in the same time period.

JIMINEZ: And the Serge module is S-E-R-G-E, right?

RUDOLPH: Mm-hm.

JIMINEZ: And they were?

RUDOLPH: They were very modular audio synthesizers. I mean, they were sort of— I guess there were different schools of thought about audio synthesis and, you know, Bob Moog's machines were probably— were by far, the most popular. So he— You know, when I've read stuff about how he started out, he didn't have any preconceived ideas of whether or not there'd be a keyboard as a control. And I think as the machines became more and more used by musicians, I *think* what happened was that they would request certain things. And then slowly, it began to evolve into something more along the lines of conventional music. There was, you know, keyboard control. Sometimes oscillators, three oscillators that generated the sound had a common control voltage from a keyboard, so that was sort of like a chord. Sometimes the sequencers, the devices that would sequence notes, could pick up in the middle of a sequence, so that was kind of like a fugue. So I mean, the kind of thing that Wendy Carlos was doing with *Switched-On Bach* was— you know, kind of made sense; but I don't know whether those devices— It'd be interesting to see whether those devices were made specifically because customers or potential customers were asking about them, or whether he came up with these things and then other people decided, Hey, I could— you know, that idea applies to these types of music. But it seemed like with the Moog synthesizer, even though it has a great sound, it was gravitating more and more towards conventional music ideas; whereas the Serge, I don't know the history of the Serge, but it was a *lot* more modular. In fact, I don't know

RUDOLPH (Cont.): if you're familiar with some of the devices on the yellow boxes, but there's some things where in order to get it to oscillate, you have to do a little feedback loop, where you have to take the pulse output of it and feed it back into the input just to get it to oscillate. So it was really modular.

JIMINEZ: So that, yeah, maybe you could talk a little bit more about those yellow boxes, because those were really the first boxes that were in there that were built by—

RUDOLPH: Rich Brewster.

JIMINEZ: Rich Brewster.

RUDOLPH: And I know Rich was interested in both *Electronotes* and Serge modules. And he really would be the person to talk to, I think.

JIMINEZ: We have to find him.

RUDOLPH: Yes. The other person to ask about that is Peer, because Peer was around during that period that Rich was building those things. And in fact, Rich built another bunch of modules for himself that he eventually sold to Peer.

JIMINEZ: So what were they really used for, those yellow boxes? And they're still used, correct?

RUDOLPH: Yeah. They were used for control voltages for video, and they were also used to generate audio. So they can, you know, generate audio sounds. But they were all, I think, based on other designs in audio synthesis. And what that also meant is that the oscillators only have a certain frequency range. So there's this— You know, when you use oscillators as a video source, when you plug an oscillator directly into that place on the Matrix that, you know, cuts it down to two volts and you can see it right through the output amp as a raw signal, when it's low voltage, it's just going from black to white. If it's a square wave, it's just black for a while, then it's white. If it's a sine wave, it's gradually raising up and gradually coming down. And there's that threshold point called sixty cycles, where— That's where the oscillation, that's where the frequency is happening faster than each field of video. So then what happens is it starts to break the image up within the field, so that so many scan lines are white; if it's a sine wave, so many scan lines are white, so many scan lines are middle gray, and so many are black. And then when you go from there, you start getting more and more horizontal lines. Then the next threshold point is when the frequency happens faster than each line of video. So whatever that frequency is, like 525 times 30. You know, so that's up around 16 kilohertz or something like that. And that's where it gets very chaotic and starts to— you know, it wants to oscillate within each line of video. And that's usually where you have to give it— oscillators have to have a synch input so that you can give it horizontal synch, so that it will— in order to stabilize it, in order to see these vertical divisions, that the oscillation has to be happening at the same time on each line.

JIMINEZ: Right. So that's— Go ahead.

HIGH: Sorry.

RUDOLPH: Oh, I'm sorry. So anyway, those frequencies, when you start getting up there—you know, 16 kilohertz, that's already starting to get out of the audio frequency range. I mean, the oscillators that were built for musical purposes, including the dope for[?] modules now, probably only go up to about 20 kilohertz, I'm guessing. I'm just pulling these figures out of my ass; I have no idea. So they weren't really designed to do video stuff. So I think the next generation of oscillators that David came up with when he built those[?] bank of oscillators, was to start going up— number one, to have oscillators that have an external synch input; and number two, to have oscillators that could be divided up— you know, that could be high enough to divide up so you start getting vertical shapes.

JIMINEZ: Right.

RUDOLPH: Because it's the mixing of the vertical shapes and the horizontal shapes that you start making more complex shapes in oscillators.

JIMINEZ: And then from there, people would use a keyer to assign certain video to certain parts of the tone range in the image.

RUDOLPH: Yeah. I mean, once it's going into that input to[?] video input, then it be sent to anything, just like any other image to like a camera or a timebase corrector or anything else. It can be sent to the keyers or the colorizer or any of those things. Now, separate from the history of the Center, people were already doing that. I mean, Steve Beck. Don't know much about the history of his stuff, but he called his stuff video synthesizer or video—

JIMINEZ: Yeah, and he had the video— I forget— Well, it was a synthesis and then there was the Weaver…

RUDOLPH: Right.

JIMINEZ: …which I think was more complex, in terms of using those horizontal and vertical shapes.

RUDOLPH: Yeah. So he had to— And then the Sandin had its own oscillators. And those were already up in the high frequency, where they could start to divide up the stuff. But in terms of the Center, I think that was how things for progressed, first starting with the yellow boxes, where you could get— If[?] there's two oscillators, you can get a line going this way. You know, two—

JIMINEZ: Up and down [inaudible].

RUDOLPH: Two of the oscillators that are on the yellow boxes have a three-way synch switch that's either free-floating or horizontal synch or vertical synch. And then they can get up to, you know, whatever that high end of the audio frequency range is. So you can get a bar going this way and then mix it with a bar going that way [inaudible].

JIMINEZ: You have the vertical and the horizontal, yeah. So the four-board[?] project— and I know that was prior to you coming to work at the center, but the four-board project then, as you said, was— Oh, the bank of oscillators that Dave built, they were part of the four-board project and they were intended to provide these higher frequencies?

RUDOLPH: Again, that was— There was a period where I was working full-time at the local PBS station and was, you know, sort of not around much at all. Even though I was living Owego and Peer and I were housemates, [laughs] I wasn't— There was a lot of stuff going on that I didn't have time for, like the Tuesday afternoon thing and— Peer and I were the only people with jobs that I can remember. [they laugh] Neal didn't have a job, David didn't have a job, Mimi[?], Matthew. Yeah, so you know. But anyway, [laughs] I had a job, so I was busy doing that. But I remember those oscillators were hand wired. You know, the oscillators at the Center, they're not part of— David later, you know, built the boards, printed circuit boards, but we don't have those. The oscillators were hand wired. Peer would have to tell you who did that.

JIMINEZ: So the idea was, let's expand the capability of the system in these specific ways, and applying for money to do that. But you're saying maybe the ones that David built were— the ones that are in the Center now that David built were prior to the four-board project.

RUDOLPH: Yeah. I think they met the requirements for the four-board project somehow, but they were actually built before the rest of the stuff came in. So we added that bank of eight oscillators. "We;" I mean, I wasn't working at the Center at the time, but—

JIMINEZ: And which color is that, because I know that's— when we go to refer to my pictures—

RUDOLPH: It's a yellow— it's also yellow and it's rack-mounted. And it's just eight identical modules.

JIMINEZ: So I mean, because the idea with the four-board project was to create some kind of— the printed circuit boards that could be done and distributed.

RUDOLPH: Yeah.

JIMINEZ: The designs would be distributed.

RUDOLPH: Mm-hm.

JIMINEZ: Correct? But I don't think that ever really came to pass, so—

RUDOLPH: Right.

JIMINEZ: So the four parts, the four boards, the four actual boards were—

RUDOLPH: The oscillator, the keyer, the sequencer, and the colorizer. I think that's— And then I believe that the framebuffer was a separate grant that Peer and David did. And I think—and again, you should as Peer and David on this—but I think the idea was to have one at the Center and then Peer would get one. And I think that was in a couple of different stages. The first stage was just a single framebuffer. And if you look at a lot of Peer's early work, I mean, it's just— it's using that single framebuffer. And Peer and David did put together some hand wired prototype of that. So that was separate from the four-board project, but the four boards were the oscillator, keyer, sequencer, and colorizer. Now, the keyer and colorizer were really refinements of what was already there. You know, what David had built by hand, hand wired. Because there was a black box that was a hard edge luminance keyer, voltage controllable; and then there was a four-channel colorizer. I think that was built around '73 or something like that, and Walter was involved with that. So this was kind of a refinement of those two things.

JIMINEZ: Mm-hm. And then the sequencer?

RUDOLPH: The sequencer, David— There was a sequencer at the Center, a four-channel sequencer. I don't think that was David's; I think that was something that Rich had built, maybe with David's advice or— I don't know where the original— But David's sequencer— There's a case where David's sequencer, I think, was a major improvement, a major step up from the sequencer that was there, because it was— Well, it was eight channels instead of four; it had individual pedestal controls for each channel; it not only had a standard— You know, it had different modes. So besides being able to manual switch and besides being able to put a pulse in to sequence through in the order that you put them in in the matrix, it also had this thing called binary control. And that was, there were three switches that also had corresponding control voltage inputs. It wasn't the idea that people memorized what[?] binary control, but it allowed you to put in asynchronous control voltages to build up to more complex patterns, rather than standard zero, one, two, three, four. The sequencer's an eight-channel sequencer, but it's labeled zero through seven. So it really was a big improvement over the sequencer that we had.

And then when Matthew was hired to finish these, to actually build them, he did add a few things on his own. I think on the sequencer, I think it was Matthew's idea to add the plus/minus five output so it could be used as a sequencer in other ways. You could sequence audio, you could sequence control voltages. I think he also added the individual clip selects for each channel of the colorizer. So there's those six. In the lower right-hand corner of the colorizer, there's those six switches that are each six positions, and it's like a rat's nest of cables that allowed you to do that. I think he added that and a few other things.

JIMINEZ: So how do you— I mean, I think the keyer and the colorizer are probably more easily understood by people who are less familiar with the system. You know, it sort of refers back to regular old video language. But the sequencer, how do you describe the sequencer when people come to work, simply?

RUDOLPH: I start off by saying it's kind of a voltage controllable switcher; and if they don't know what voltage control means yet, I say it's kind of an automatic switcher. But that's a really simple explanation, because switching can happen below and above the field rate. So you can actually start switching within the image. You know, so it could be kind of a— especially with the binary control, once you start putting in an oscillator— you know, going this way in an oscillator, going that way—you can start to build up a split screen of various images. So a sequencer does a lot more than just switch. And that is something that needs voltage control in order to start— Yes, you can manually switch, but that's not particularly interesting. Whereas on the keyer and the colorizer, I think voltage control adds a lot to it, it's not necessary to use them; whereas on the sequencer and the wobbulator, it is necessary to have some sort of voltage control happening.

JIMINEZ: And people are making more complex shapes, is what they're doing with the sequencer. With a combination of devices, really, with the[?] sequencer and the keyer.

RUDOLPH: Yeah. I mean, a lot of these devices are really simple. You know, the keyer is a really simple thing and the sequencer's a really simple thing. But because of the way it's set up at the Center, with the Matrix switcher, and the fact that it's very modular and very open-ended, in terms of it doesn't presuppose any order things go in, you're really starting off with simple machines and building more complex ones. So that idea, also, that idea of modularity, is really borrowed from— modularity combined with voltage control are really both borrowed from audio synthesis.

JIMINEZ: Right.

RUDOLPH: I think the Sandin took it to a much further level, because— I mean, because David's machines kind of do act as stand-alone devices. You can buy a sequencer by itself or you can use the keyer by itself, but still build them up to more complex devices. But the Sandin really kind of, in some ways, breaks it down even more. Like the outer multiplier is sort of the generic image combiner. And depending on what kind of control voltage you put in or what you feed into the clip input, it could be a sequencer, a cross fader, you could do wipes, it could mixing and it can do keying. So kind of like all of those ideas are in the outer multiplier.

JIMINEZ: Interesting. So maybe we can move on, unless, Kathy, you have anything about voltage control or those—

HIGH: Well, I have one, a little bit more generic question, which is just when you have people who come to the Center now who are younger, who haven't been dealing with any analog video, and in fact are maybe dealing with HD exclusively in their video experience, do you have to backtrack and explain things like what a field is, what a frame is?

RUDOLPH: Well, you know, the HD debacle hasn't hit us yet. [laughs] It may not.

HIGH: But I mean, it hasn't hit because the equipment isn't set up for that. But I mean, in terms of just people's knowledge, is there a certain amount of kind of— Do you find now that you're explaining just sort of like basic video concepts more [inaudible]?

RUDOLPH: [over High] Well, here's the interesting thing. I mean, in the past ten years, we're getting more and more people that understand the concepts, because— well, because of a number of things. One is that there's been a lot more interest in live video. People are performing, and that kind of covers the range from low art VJ-ing up to, you know, people performing in other contexts. So there's that. But they're mostly using software to do that, like MAX/MSP/Jitter or Quartz Composer or VDMX or— You know, there's a bunch of things out there that can do that. So they understand this concept of real time, they understand the concept of modularity…

HIGH: Right.

RUDOLPH: …of external controls. Plus, there's kind of the DIY aesthetic that's out there. So people understand about building controllers. What they haven't done is work with actual hardware that does this. You know, they know about this place, they know the history. And how that will come about will— I mean, these systems all work— not exclusively, but they work well with multiple inputs. And they come up and all of their stuff is on their external hard drive. All of their source material is— There are QuickTime files on the external hard drive, but they want to mix them through the system. And they haven't really thought about the idea that they have to be separate pieces. Like, we have to spread that out. We either have to get some of this stuff on tape or we have to spread it out over other computers, so that those can be sources through TBCs and into the system. So that's really interesting. It's like they really understand the concepts more than people did twenty years ago.

HIGH: Right.

RUDOLPH: But they haven't had to work with— or they haven't had the opportunity to work with the hardware.

JIMINEZ: And so is that more like After Effects compositing or something, versus having really multiple sources coming from different devices?

RUDOLPH: Yeah. And I mean, when they work with those programs like VDMX and Jitter, they are doing the same things. You know, they're just virtual machines, these little objects, that they're patching together. And the order in which they patch them together determines how they're layered. And then there's external controls that can work on some of those objects simultaneously. So it conceptually is the exact same thing. But they haven't done anything with the hardware. Or haven't had the opportunity to work with the hardware.

HIGH: Fascinating.

RUDOLPH: I haven't had a lot of people— I mean, so far, we haven't had people come through— I mean, you know, HD is relatively new, so we haven't had people that were only— you know, went to school and only used HD and then they come here and they only have HD. So that hasn't happened yet. But you know, that's another— I don't know how that's going to manifest itself. I mean, I have mixed feelings about HD. [laughs]

JIMINEZ: [inaudible]

HIGH: We all do.

JIMINEZ: Yes.

RUDOLPH: Because it seems like its purpose is to up the ante on what everybody needs, in terms of hardware and software, and make everything else before it undesirable. So if that's the goal, mission accomplished. But there's nothing conceptually interesting about it. it's just more pixels.

JIMINEZ: Yeah, it's really complicated when you start to take SD into HD and—

RUDOLPH: Yeah.

JIMINEZ: For preservation and the choices that are made, really, it's crazy.

HIGH: But anyway, that might be a— Thank you, that was a great answer. And it might be a good lead in to— Are you going into the A&D thing now?

JIMINEZ: Yeah, and I mean—

HIGH: Because that would be interesting, to sort of lead into that.

JIMINEZ: I thought— Well, I guess if you want to talk about the way that digital devices, or the concept of digitization and digital, I know that digital control voltage is perhaps— I mean, how was digital thought about, in relation to the system? If you remember.

RUDOLPH: Again, that was already happening while I was a student and not involved with it. But I mean, there's— Let's see. I know that Paul Davis was around very early on in the late seventies, and David, thinking about these things. And I know that there's that tape that David made, one of his early framebuffer— I think it's on the DVD compilation that was[?] the framebuffer he made for Gary Hill. And then there was also the Vasulkas. They were the pioneers; we were taking our cues from them. And there was that whole thing about— What is it? The LSI-11, I think it was.

JIMINEZ: The digital image articulator?

RUDOLPH: Yeah. Yeah. And I know there were issues about, okay— Woody wanted to learn, you know, programming from the ground up, and that wasn't a practical idea. We already had to have something that artists could come in and use. So whatever we did, it wasn't going to be the same concept as it was in analog. But I think, looking back— I know I'm jumping around here, but— One of the concerns that was there was the idea that camera images would be involved and that there would be some real-time element. And that's where people got very excited about the buffer. And I remember in that one book about *Machine Media*, I think the Vasulkas' book, there's a quote from Steina where she said, "We would've sacrificed any resolution [laughs] to have real time." And I think that's a really important distinction, because most people, to this day, the goal was to emulate what existed before, not call attention to the fact that it was digital. And that really is the desired thing, to have so many pixels crammed in there that you don't know it's a digital image. And I think that's very different from how it was approached by the

RUDOLPH (Cont.): Vasulkas and, you know, whoever was around for ETC. I mean, because there was this whole thing about coding, C-O-D-I-N-G, and you wanted to see the process happening. So we kind of like— people embraced the pixels. The pixels were exciting, because it showed that there was a process happening. And since so much of this stuff was about exposing what the process was, that was a really interesting idea to people. And it was important that it was real time because that was its carry-over from analog video.

JIMINEZ: Can't even get[?] a good pixel anymore.

RUDOLPH: Yeah. [laughs] Exactly. And there were some machines, like the Spatial and Intensity Digitizer, which I think was this accidental machine. I think they were start— Don McArthur and— they were trying to build a timebase corrector, and somehow things went awry and they came up with this device that was very noisy, very glitchy, and it didn't really do anything except signify digitization, right? I mean, that's all it did. It didn't store, it didn't have a buffer, it didn't reassign pixels or remap anything or— It just— that's analog to digital in, digital to analog out. And you know, I remember being so excited [laughs] there was a machine that could do that. So that was one of the very early, but short-lived video devices in the system. I think it kind of just died.

JIMINEZ: Yeah. So the first concept was to just see— to be able to capture it, as you said, analog to digital, digital to analog, because there's no way to store it. But then the buffer idea is about storing video, for however short a period of time, as the video[?] in

JIMINEZ (Cont.): real time. So could you talk about that and how— I mean, you mentioned that Dave had built the one buffer, which might've been in the system. But then I know that you had told me about the Amega being incorporated into the system, too.

RUDOLPH: Yeah. Well, there were several things— Let's see. There were some things that were in the system and are no longer in the system. Which is very different from analog, because the analog stuff— I mean, we still have the wobbulator, we still have a colorizer. Those things have been in the system since the seventies, whereas things have come and gone. One of them was the— God, I can't even remember the— But the Cromemco computer that David Jones was doing most of he hardware for, and Paul Davis was doing most of the software for. And they used one of the boards— It was this, you know, big thing with the big eight-inch floppies. The Center bought a commercially available framebuffer called the Cat[sp?] buffer. It wasn't real time. I mean, it— Okay, it was real time; it kind of flashed between each grab[?]. You remember using it.

HIGH: I remember using it, yeah.

RUDOLPH: Yeah. But the interesting thing about that was that I know Ralph was very interested in, what else can you use as a control, besides a keyboard. And I think it was partially out of that, that Dave came up with the D+7A device, which was a box of knobs and control voltage checks that was connected to the computer; and then in collaboration with Paul, they wrote software for controlling— for remapping and doing various other

RUDOLPH (Cont.): types of digital manipulation to the images that were captured in the Cat buffer. So the Cat buffer was the analog to digital and digital to analog thing that interfaced with the audio— with the video, analog video stuff. And then this controller was what allowed you to, when you called up certain software, to control certain aspects of it. And of course, there was a delay, there was a significant delay in using it, so it wasn't a real-time device. But the thing that was really interesting about it is I really thought that was a precursor to all of the kind of stuff that people are doing now with the Arduino board and everything else.

JIMINEZ: And could you elaborate just a little bit more on that board? I'm not familiar with that.

HIGH: [inaudible] how you mean that. Describe that relationship between the Cat buffer and the Arduino. What exactly?

RUDOLPH: In that you had— you know, you were working with an external control that wasn't just the keyboard and the mouse; that you could— You know, you suddenly had a— Well, knobs for one thing, but also control voltage inputs. So it was a way of really rethinking what your interface was to the computer. And I think that's a lot of what people are doing now with Arduino, and even buying MIDI controllers, off-the-shelf MIDI controllers and figuring out all the different ways they could interface with the computer by building light sensors for the Arduino board and all sorts of sensors like that. That was really the first time I had really seen that. And I don't know who else was doing

RUDOLPH (Cont.): that. So I think that was unique, and I think this idea of having real-time video, no matter was the resolution was, was also unique.

JIMINEZ: Yeah, because I mean, there was no mouse at that time. Do I mean, I think that probably in other disciplines, there were people working on different interfaces to computers. But in our discipline, that was very exciting. That particular experiment was very exciting. But is that separate from or the same as the— And when you talk about control voltages into the computer— I mean, are you talking about analog control voltages in? Or are you also talking about the computer acting as a— generating control voltages?

RUDOLPH: It did have that capability of putting out control voltages. I'm just trying to remember how many— Because one of the programs— one example of that was this program that they wrote called Sensor[sp?]. And Sensor was based on the idea— you know, people back in the day used to put light sensors— you know, get your light sensors from Radio Shack, but them on the screen, tape them to the screen, and then send them out as control voltages so they could control audio and various other things. So I remember that David and Paul had some sort of program called Sensor, where it would take the image coming in from the Cat buffer, and you could plot X-Y coordinates for four sensors; and then depending on what the gray levels were for that particular pixel, you know, as they changed they would put out corresponding voltages at the output. And that was all plus/minus five in and out. I'm a little fuzzy right now on what other

RUDOLPH (Cont.): programs used the output. But the potential— the hardware was there. That was one I used a lot, so I remember— do you remember that at all?

HIGH: I don't remember that. I don't think I used that. I was using the Cat buffer, for sure.

RUDOLPH: Right. And this is, like '84.

HIGH: '83, '84, something like that, yeah. But I don't remember using the computer, that tweaking of it.

RUDOLPH: Yeah.

HIGH: I might've and I'm just forgetting it.

JIMINEZ: I mean, do you think that— Was there a frustration with the sort of looseness or whatever of an analog signal, the variability of an analog signal, and people were interested in the standard— you know, sort of the clock of the computer as control voltage? Or was there something else going on? I mean, you know, one interest might've been—and I think that this might've been expressed in that digital image articulator, possibly—is getting a standard— You could create a sequence, in other words, of control voltages, that could then be fed in; and you would know— There was a certain

JIMINEZ (Cont.): predictability to that, right? If you have a digital control voltage, you don't have the variability that you might with an analog, as it's coming through various devices and—

RUDOLPH: Yeah, yeah.

JIMINEZ: You know, so you're[?] mushy, more mushy, in a way.

RUDOLPH: So you mean like being able to digitally score control voltages?

JIMINEZ: Yes. I guess that would be— Like sequence them and—

HIGH: Or to repeat something?

JIMINEZ: Yes, or repeat; that could be another thing.

HIGH: To go again[?]?

JIMINEZ: I'm just curious. I mean, I just imagine that those would be benefits…

RUDOLPH: Yeah.

JIMINEZ: …to having digital, as opposed to analog control voltages.

RUDOLPH: Right. But I can't remember anything on that system that did that. But I could be wrong.

JIMINEZ: But then once the Amega was introduced and the Center got the first Amega 1000, was that an aspect of— And as I understood, that controlled the buffer.

HIGH: When was the Amega introduced into the system.

RUDOLPH: Yeah, good question.

HIGH: That's okay. I just want to make sure we get that date, because I think it was there when I came up in '83.

RUDOLPH: I don't think— No, it wasn't.

HIGH: No? Then it must've been a later trip.

RUDOLPH: There was the—

JIMINEZ: I don't think it was invented till around '84.

RUDOLPH: Yeah, I think it was even later.

JIMINEZ: Or ’85.

RUDOLPH: I’m thinking like ’86.

JIMINEZ: ’86.

RUDOLPH: Yeah. I think when we got an Amega in the— So I think the order of things was that Cromemco or Z-2 or whatever it was, with D+7A box and the Cat buffer.

HIGH: That’s right. Yes.

RUDOLPH: Then around the time that the four-board project was finished, the first framebuffer came in, the sixteen frames. And I think the Cromemco controlled it.

HIGH: Mm-hm, mm-hm.

RUDOLPH: Yeah. And then after that, the Amega came in. We got an Amega 1000 and David rewrote the software and built another interface that fits on the side of the Amega 1000, and then that became the controller for the framebuffer.

JIMINEZ: And it was a GUI interface.

HIGH: Because that’s what I remember working with.

RUDOLPH: Yeah.

JIMINEZ: A GUI interface using a mouse as opposed to a keyboard or—

RUDOLPH: Yeah. I think the reason we were doing that is because the Cromemco was having permanent problems. You know, problems that were not easily resolvable. And I think they were related to the hard drive— or not the hard drives, the floppy drives. I don't remember the details, but that's why it was eventually taken out of the system, not because it was no a longer relevant [chuckles] idea, but because it was just—

HIGH: Right, right.

RUDOLPH: It was too hard to—

HIGH: Too buggy.

RUDOLPH: Yeah, too buggy. It was having a *very*, very hard time booting up, I remember. It took several, several tries. And so David— And then, also I guess David was thinking about, well, you know, if he sells the buffer, what would actually control it? And the Amega had come out and what was the interesting thing about the Amega was that it was a computer that you actually— you know, actually had a video output. You could record what was going— And a genlock input. So it was something that actually fit right into what we were doing. We had this kind of general system and we were always

RUDOLPH (Cont.): trying to figure out, well, how do you get a video in—and you know, we still have that question with the Ma— How do you get a video in and out and how do you lock it up to the synch of the system synch generator? So the Amega seemed to be ready for that. David could also tell you stor— You know, jumping back to when David was putting the Cat buffer in and having these conversations with the people who built it, he was trying to talk to them about what he was trying to do. And at the time, you know, they just— Their responses were, "Why do you want to do that? Why do you want to mix digital stuff with video?" You know, so there really was this complete lack of foresight, [they laugh] on the part of the people that were involved with computers.

JIMINEZ: Right. But then in the broadcast environment, of course, there were early character generators. And one of the things that the Amega was useful for, also was— I mean, was for titling, right?

RUDOLPH: Yeah.

JIMINEZ: But did you see much of that in the beginning? Or was it immediately seen as a good device mixing?

RUDOLPH: Yeah, it was seen— Yeah. It wasn't a real-time processor. So you know, you still— you had to— I mean, it was an image source at first. So you could capture— There was always some sort of device— I think DigiView was the early device that you could capture still things. And then you could bring them into other things like Deluxe

RUDOLPH (Cont.): Video or other things that did slide shows. Or TV Show was another early program. And then you could output that as a source into the rest of the analog system. And you didn't need the TBC for it, because you had the genlock. And then eventually, Deluxe Paint, the third version of Deluxe Paint had the animation capabilities. So it wasn't a real-time processor. I think until the A-live[sp?] board came about, InVis— Wait, no, that's not InVision.

JIMINEZ: Live, yeah.

RUDOLPH: Yeah.

JIMINEZ: It was Live[cap?].

RUDOLPH: And that was like a very, you know, low-end digitizer. But it still had these real-time capabilities. And then that was, I think, the first device that allowed you to plug video into it. So we could take video from the system, you know, go into that board, and then out of that board, back into the system.

JIMINEZ: And then I remember using, of course, the Amega as a keyer, as well, creating a kind of a stencil within Deluxe Paint, and then using it as a keyer. Do you find that that was used a lot[?]?

RUDOLPH: Yeah, that was a very common use of the Amega. You know, because as an image source, a lot of people did use it and put it into the clip input of the keyer. So all of a sudden, just even working with white on black animation, suddenly you had these much more complex wipes and split screens that you could do with the images. But what the Amega didn't have was external control. Nobody was building— there was no D+7A box for that. There was MIDI control, but I never quite got it together in figuring out how to use MIDI control intelligently. And this is the eighties, so MIDI was big then, right? Voltage control devices were just being, you know, given away because people thought they had no value and MIDI was going to take over. So there were more and more MIDI devices out there at the same time. But that's not something that ever kind of came together at the Center, in terms of MIDI control of the Amega. And I think in the early nineties, we got a little set of sliders from JL Cooper, the MIDI FaderMaster. There were basically eight sliders that could put out MIDI signal, you know, MIDI numbers from zero to 127; and then David modified that for control voltage inputs. But there were still a lot of things we couldn't use it for because it didn't do note number or some of the— You know, it didn't address some of the things that the MIDI devices we had were able to do. Like we couldn't plug in control voltages and— or use even the manual sliders and use it to control notes on one of our MIDI keyboards. In fact, there was a long period where I wasn't quite sure what to do with it, until Jitter came around. And because Jitter was so open ended, as to how— MAX/MSP/Jitter was so open ended, as to how it used MIDI devices that now it's being used more than ever. But it was like this long gap between when we had it when it really was used well.

JIMINEZ: Well, the good thing; nothing gets thrown away. It stays in the system.

RUDOLPH: Right. [they laugh] I know I'm jumping around here.

JIMINEZ: Now, that's fine. No, no, that's fine.

HIGH: It's really interesting.

JIMINEZ: One other thing that you had mentioned when we talked previously was the real-time audio processing. And was that something that the Amega couldn't do?

RUDOLPH: It could. I mean, first— Okay. Again, these were these little external devices that hooked to the back, to the serial port, but they were audio digitizers. And a lot of them were made for capturing and sampling and replaying and things like that. But some of them were real time, and it was— I think there was a guy named— I think his name was Henry Lowengard. And he wrote this program Harmonizer that did a lot of real-time processing of the audio signal.

JIMINEZ: It ran on the Amega?

RUDOLPH: Yeah, it ran on the Amega. We still use it, even though it's just an eight-bit processor, it's kind of— you know, it's muddy by today's standards, but it still does things that I haven't heard on other sound processing programs. That was the other

RUDOLPH (Cont.): interesting thing about the Amega is that there were all these people out there writing applications. I mean, Apple, quite frankly, is so fascist, [laughs] compared to— You know, I mean, trying to crush people that are making applications for the iPhone and things like that. There was none of that. I mean, nobody had any preconceived ideas of what digital video was. And there wasn't this professional model, that it had to look a certain way, so people were free to just invent stuff and make stuff. I mean, there was more software coming out than I had time to ever figure out how to use. I mean, just a lot of stuff like that. And one of the things that came out of it was this public domain audio software by Henry Lowengard that we still use. Yeah. I mean, I think there's things like that going on in the community now, with people making plug-ins for Quartz Composer and Max/MSP and things like that. But there wasn't— There seemed to have been a big gap in—

JIMINEZ: After the Amega was phased out and before Max/MSP and Jitter.

RUDOLPH: Yeah. Mm-hm. Yeah, so the idea of external controllers and the idea of people writing their own applications and plug-ins all seemed to come back now in more recent times.

JIMINEZ: So some of the old tools like— I mean, obviously, all the analog tools are still there; but the Amega is still there in the system, it just might be an Amega 2000 or 3000, as opposed to a 1000. Still running, still interfacing with the Jones buffer.

RUDOLPH: Yeah. I mean, one thing— There were a lot of peripherals built for the Amega. And one of those was the timebase corrector. And those were machines that were very, very expensive. They were like $10,000 in 1970s dollars.

JIMINEZ: Timebase correctors in general, yeah.

RUDOLPH: Yeah. And then really, the Toaster— I mean, we didn't talk about the Toaster, but that was the first actual real-time processor—you know, full-resolution real-time processor board for the Amega that you could actually plug multiple sources into and genlock it and combine them out[?]. So in that way, it kind of fit into the Center. But the way it didn't fit into the Center was that it was so locked in to it's applications. It was the very opposite of the kind of open architecture or open systems that the Center had. Basically, the way it was marketed was it had these really cheesy effects. There was no way for people to write their own ap— Unlike the Amega. You know, people were writing applications for the Amega itself. That wasn't happening with the Toaster. There was no equivalent. You just had to wait for the next version of the Toaster, which had more cheesy effects. And a better character generator. So there was sort of a love/hate relationship there. But the one thing that it did was it created this cottage industry for other things. So all of a sudden all these other kind of analog devices that, you know, had been around, like the timebase corrector, the waveform monitor and vectorscope, and even distribution amps, were all being built as boards that could go inside the Amega computer. And they were pretty cheap, because they didn't need their own power supply; the Amega was the power supply. And they were real-time analog devices. And you

RUDOLPH (Cont.): know, we still use the timebase correctors. I still have bought them off of eBay for myself and Ralph has gotten them for the center, and they've been very reliable. And that's what we've been using. So the Amegas get used every day at the center for controlling those timebase correctors. And then the secondary uses are probably Harmonizer at the Live board, and not so much Deluxe Paint anymore.

JIMINEZ: Deluxe, nobody knows how to make[?]. [Rudolph laughs] They've got[?] stencils or whatever in Deluxe Paint anymore.

RUDOLPH: And then as you said, the Amega 1000 is still being used as a controller for the buffer.

JIMINEZ: Okay, great. Is there anything else you can think of, in terms of analog to digital, digital to analog that we've missed?

RUDOLPH: Oh, I'm sure there is, and I feel like I just gave a really scattered— I did better with the analog stuff, [laughs] and I got really scattered with the digital stuff.

HIGH: Mm-mm, mm-mm.

RUDOLPH: I'm sure there is. I guess the next big thing that excited me with digital was Max/MSP/Jitter, because it had an architecture that was so similar to what was happening with the analog system here. And Sherry paid to have Aaron Miller tutor me. That

RUDOLPH (Cont.): happened a couple summers and then by Peer[?]. And I remember we were both— like really, it's like Peer saying, "Finally, something interesting with the Mac." And that really was our feeling.

JIMINEZ: Yeah, so you didn't really see much use for the Mac or another computer in the system prior to that?

RUDOLPH: I won't say that. I mean, we had it.

JIMINEZ: From about when?

RUDOLPH: I'm thinking '99. So very early versions of Final Cut. I think we had Final Cut 1. There again, Final Cut was a source into the system. Like people could— Because it could do things— You know, like you could firewire out into, you know, a DV to analog converter into a timebase corrector, and then that could be fed into the system. And it could do things that analog couldn't do. Like you could loop things pretty easily. That was very practical, when you're setting up your patches, just to be able to loop. It could play things backwards, it could do things in slow motion or fast motion. Or you can just slap together some really simple cuts and then just play them from the timeline, and then use them as a source into the system.

JIMINEZ: But they're basically going through[?] D to A, you're saying.

RUDOLF: Yeah.

JIMINEZ: Yeah, to get into the system.

RUDOLF: Mm-hm, yeah. And then when we had two Macs, then you could have two sources into the system. So there's that. And then also, more and more now, people are recording onto Final Cut. So in other words, you're still coming analog out of the system into a DV deck. And you can record onto the DV deck; but what happens just as often is that there's a firewire cable that runs from that DV deck into one of the Macs, and then people just record onto their external hard drive in real time. Those are kind of practical but boring applications, where you're basically using the computer as a playback system or a record system.

JIMINEZ: Right.

RUDOLF: And you're not using it in between for the processing part, like you would with Max/MSP/Jitter.

JIMINEZ: Right. Well, great. I mean, I'm noticing that it's about twenty after four, so we probably have to wind it up [inaudible]. Do you have anything else, Kath, that you want to ask?

HIGH: No, this is great. And I don't think you jumped around, because I think that actually, the digital stuff does jump around.

RUDOLF: Yeah, it does.

HIGH: So that's why— I mean, if you feel that, I think that it's actually a kind of interesting record of how things were introduced, also.

RUDOLF: Yeah.

HIGH: So I don't think you should think that you jumped around. It's a kind of really good description of the reality of that, you know, transition between A to D and D and A and, you know, how things went back and forth from that point on, so—

RUDOLF: Yeah. I think, also— I mean, the buffer was a really important component in the system, because it just did play into the— you know, because it was designed by David, and he knew exactly how he wanted it to play into the other real-time systems and, you know, took an idea like a luminance keyer and used it to key between different areas of memory in the buffer—which I still think is an amazing idea. [laughs] It really still kind of blows my mind that he came up with that. So yeah. So that was a really important element in the system. But you know, it was so seamless with the rest of the system, I almost don't think of it as digital. You know, I think the digital stuff is all the other stuff we had to struggle with.

HIGH: Mm-hm, mm-hm.

JIMINEZ: Well, I mean, that always kind of makes me laugh because, of course, timebase correctors do an A to D conversion. You know, there are A to D conversions happening within devices; but then digitization or capture is something altogether different.

RUDOLF: Yeah, yeah.

JIMINEZ: But there's digital stuff happening…

RUDOLF: Right. Right.

JIMINEZ: …before capture is possible.

RUDOLF: Yeah, mm-hm.

JIMINEZ: Or the input. Like you say, before you're able to get video in and video out of a computer.

RUDOLF: Yeah. Well, you should talk to David about the timebase correctors he's building, because they have digital as— they have very digital— I mean, he decided he needed to have timebase correctors for his system, just because they're so hard to get

RUDOLPH (Cont.): ahold of. And then he decided the timebase correctors are actually boring, so he just, like, decided to add all these other things to them. So maybe you can get him to talk about that.

JIMINEZ: Yeah. Alright, well, thanks so much.

RUDOLPH: Sure.

HIGH: Thank you.

JIMINEZ: Really great. We'll just stop this baby, I guess. Or do we pause it? [END]